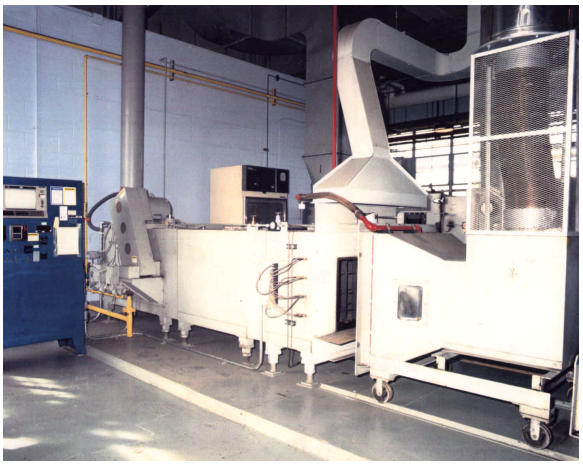

Figure 8.4 – Heated air tester

downstream face of the unit. By indirect reference, this test is a requirement of all U.S. nuclear application specifications (see ASME AG-1, Section FC-5160).[3]

8.3 QUALITY ASSURANCE INSPECTION AND TESTING OF HEPA FILTERS

HEPA filters are critical to the safety of workers and the public in the event of an accident at a nuclear facility. The greatest care is taken to ensure these filters perform both as designed and as assumed in the facility safety analysis. The U.S. Atomic Energy Commission (AEC) identified the need for QA testing of HEPA filters between 1957 and 1958. During this period, the AEC randomly selected filters from stock, and a significant number were found defective. In 1959, the AEC initiated QA testing at the Hanford and Edgewood Arsenal sites. Operations at the Oak Ridge FTF (ORFTF) and Rocky Flats FTF (RFFTF) followed in January 1963 and 1974, respectively. Historically, these FTFs have provided over forty years of progressive QA testing and delivering of a critical quality component. The ORFTF is the last of the three DOE HEPA FTFs remaining. DOE continues to perform 100 percent QA receipt inspection and efficiency-pressure drop testing on certain HEPA ventilation filters produced for use in DOE nuclear facilities. This is to ensure that filtration efficiency meets DOE's specification requirements. Such QA testing ensures that the last barriers of protection against the release of particulate radioactivity to the environment at DOE nuclear facilities are performing as they should. Historically, the rejection rate continues to fluctuate, as shown in **TABLE 8.1** below, with a high of 18.7 percent in 1996 decreasing to 1.6 percent, then increasing to 9.8 percent and 8.1 percent in 2000 and 2001, respectively. Significant reported rejection rates indicate that vendor testing is not sufficient.[5] From this data, it is apparent that an independent test facility is necessary to ferret out any defective filters shipped through the manufacturer's inspection process.

Table 8.1 – Oak Ridge Filter Test Facility Testing Activities – FY 1996 – FY 2001

Fiscal Year	Number Received	Number Accepted	Number Rejected	Resistance	Penetration	Manufacturing Defects	Does not meet PO and/or Spec	Shipping Damage	Rejection Rate
FY1996	2643	2150	493	371	70	35	17	0	18.7%
FY1997	2916	2814	102	59	20	7	16	0	3.5%
FY1998	2305	2237	68	1	28	3	34	2	3.0%
FY1999	2362	2325	37	0	31	6	0	0	1.6%
FY2000	3597	3243	354	0	44	36	270	6	9.9%
FY2001	2713	2494	219	3	39	46	123	8	8.1%
Total	**16536**	**15263**	**1273**	**434**	**232**	**133**	**460**	**16**	**7.7%**

The operating policy of DOE's filter testing program, contained in DOE STD 3022-98,[6] calls for testing all HEPA filters intended for environmental protection at a DOE-operated FTF (ORFTF). Delivery of filters to the FTF for QA review is mandatory for all DOE facilities, and this service is also available to the public on a fee basis. When the filter manufacturer's test data are confirmed, the FTF test results are added to the information on the filter case. The test procedures at the FTF call for "penetration and resistance tests," "visual inspection for damage and visible defects," and other "visually verifiable requirements." Except for filters rated at less than 125 cfm, penetration tests are to be conducted at 100 percent and 20 percent of rated airflow capacity, and the maximum penetration of .3-ìm particles at both airflow rates is 0.03 percent, in accordance with DOE STD 3025-99.[7] Penetration tests may be conducted using a monodisperse aerosol and a total light-scattering photometer or a polydisperse aerosol with a single particle counting and sizing instrument. A QA program for the DOE FTF is contained in DOE Standard 3026-99.[8] Specifications for HEPA filters to be used by DOE contractors are contained in DOE STD 3020-97.[9]

8.4 VISUAL INSPECTION

Visual inspection is an integral and vital part of every acceptance or surveillance test. A careful visual examination should be made of each internal and external component prior to installation to verify that the items have been received in satisfactory and serviceable condition. After installation, the system should be checked as part of the acceptance test procedure to make sure that all required items have been properly installed. A suggested checklist is provided in Section 5 of ASME N510,[10] which may be used to verify that system design and construction are in accordance with ASME N509[11] and ASME N511-2001.[12] ASME AG1 also provides guidance for visual inspection in Section 5.0 and Appendix 1, Section AA-5000.[3] Preparation of the proper visual checklist is the most important part of the test procedure. The checklist should cover all major potential problems without further testing, including the relevant items identified in Section 5.0 of ASME N510,[10] and also should incorporate the field observation checklist items listed in Appendix C of ASME N509[11] where applicable. Certain items listed in the recommended checklist in ASME N510[10] are only observable prior to installing the components. Experienced field test personnel should be able to find bank leak paths of a few tenths of a percent by visual examination, as well as many other potential problems not identified by the actual leak test procedures. An example of an excellent field check list used by Los Alamos National Laboratory (LANL) is presented in Appendix A and B, respectively.

8.5 IN-PLACE COMPONENT TESTS AND CRITERIA

System tests fall in two broad categories: (1) prestartup acceptance tests to verify that components have been installed properly and without damage and that the system can operate as intended, and (2) surveillance tests made periodically after the system has been placed in operation to demonstrate its ability to continue performing its intended air cleaning function. Surveillance tests are leak tests of the HEPA filter and adsorber installations. To provide guidance for the preparation of test procedures, details of acceptance and surveillance tests are given in ASME N510,[10] ASME N511,[11] and ASME AG-1.[3] In all cases, tests should be preceded by careful visual inspection, as previously discussed in Section 8.4 above. It is noteworthy to add that a spring-loaded clamping device was developed at the Rocky Flats Environmental Closure Site to provide continual holding of HEPA filters and eliminate the need to re-enter the plenum and retorque installed filters.[39]

8.5.1 ACCEPTANCE TESTING

Acceptance tests also fall into two broad categories: (1) those that relate to the permanent elements of the system, ducts, housing, mounting frames, and location of test ports, and (2) those that verify the installation and condition of the primary air cleaning components (HEPA filters and adsorbers). Acceptance tests of HEPA filter and adsorber installations are identical to the surveillance tests of those elements and are covered in Section 8.6. Tests in the first category include leak tests of ducts, housings, and primary-component mounting frames; airflow capacity and distribution tests; gas residence time tests for